Home Care Predicts an Increase in Admission Rate and Adverse Outcomes From Community-Acquired Pneumonia

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December, 2002

Alberta Centre for Health Services Utilization Research

103-01852/

ACKNOWLEDGEMENT

The authors gratefully acknowledge the support provided by the Alberta Centre for Health Services Utilization Research, which conducts studies of how health services are used and delivered to inform health policy development and management of health service delivery. The Alberta Centre for Health Services Utilization Research is a joint initiative between the University of Alberta and the University of Calgary, funded by Alberta Health and Wellness. **The opinions and conclusions expressed in this paper are those of the authors and no endorsement by Alberta Health and Wellness or Capital Health Authority is implied.**

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ISBN: 0-7785-2374-8
http://www.health.gov.ab.ca/system/key/Research/achsur_reports.html

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SUMMARY

We described the use of home care both before and after hospitalization for community-acquired pneumonia and its impact on the rate and duration of hospitalization, re-admission, and mortality. Home care was provided to about twenty percent of patients in the period before hospitalization and about twenty-five percent of patients after hospitalization. Patients who received home care services tended to be older, had more comorbidities, and had higher mortality. Over eighty percent of patients who received home care prior to admission also received these services after hospital discharge. Patients receiving home care had higher rates of hospitalization for community-acquired pneumonia, longer hospital stays, were more likely to remain in hospital after the acute care treatment period, and were more likely to be re-admitted to hospital after the initial discharge. Significant differences were noted in the process of care for community acquired pneumonia when comparing those residing at home to those residing in a continuing care facility. For those residing in long term care facilities, the hospitalization rate did not increase with age. However, for those residing at home (with or without receiving home care), the hospitalization rate did increase with age. The different hospitalization rate for those living in a long term care facility was not explained by the incidence of pneumonia which was higher in those living in a long term care facility at all ages. Those receiving home care but not continuing care were more likely to be re-admitted to hospital within sixty days of hospital discharge.

In conclusion, home care was provided to a population of elderly persons who had high rates of hospitalization for treatment of community-acquired pneumonia. Patients who receive home care services are appropriately selected as they are older, have more "other illness", and have higher mortality. Our results suggest that home care supplemented by acute care is a substitute for continuing care services.

INTRODUCTION

The admission rate for community-acquired pneumonia varies considerably amongst hospitals [1]. A randomized clinical trial in Alberta showed that a critical pathway for the treatment of pneumonia reduces the admission rate [1] and shortens the length of stay [2] without any adverse consequences. In the absence of critical pathways, up to fifty percent of low risk community-acquired pneumonia patients are admitted to hospital [3] despite a low mortality rate and the potential of being treated at home. The decision to admit to hospital is multifaceted [4-6]. Inadequate home support may play a role in this decision [7]. Patients consider that home and hospital are both acceptable places to provide care [9] as long as care and anticipated outcomes are equivalent [10]. There are conflicting reports about the effect of home care upon outcomes such as re-admission and mortality after hospital discharge [11-13].

The provision of health care support services in the home is now considered an integral part of the Canadian medical care system [14-16]. In Canada, six provinces have legislation with respect to home care and these government sponsored programs are provided by a mix of public employees and contracted services [17]. In the United States, home care services have increased more than other services paid by Medicare [18]. Home care itself is not homogeneous, consisting of care which is primarily nursing in nature delivered by health professionals and home support including homemaking and personal care delivered by allied health workers [19]. In Alberta, home care became a publicly administered service in early 1990's. Referral for consideration of receiving home care can be made by family or any health care worker and eligibility is decided by a home care nurse evaluator. In this study, we used administrative data to describe the use of home care both before and after hospitalization for community-acquired pneumonia. The association of home care with the hospitalization rate and duration, re-admissions, and mortality was also assessed.

METHODS

Five administrative health service databases were used and the analysis was done within the protected environment of Alberta Health and Wellness governed by provincial legislative guidelines on the confidentiality of health information.

1. Canadian Institute for Health Information's (CIHI) Inpatient Discharge Abstract Database (DAD) for the province of Alberta for fiscal years 1995/96 to 1998/99.
2. Alberta Health Insurance Plan Registry File for fiscal years 1995/96 to 1999/00.
3. Alberta Home Care File for fiscal years 1995/96 to 1999/00.
4. Alberta Long Term Care File for fiscal years 1995/96 to 1999/00.
5. Alberta Physician Claims Assessment System Database for fiscal years 1995/96 to 1999/00.

Inclusion Criteria:

Community-acquired pneumonia was defined as the most responsible diagnosis (MRD) or any of the other 15 International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes defined to be Type 1 (pre-admit comorbidity) with the ICD-9-CM values of 480.x to 487.x (pneumonia) or 507.x (aspiration pneumonia) excluding 484.x (pneumonia of infectious diseases classified elsewhere) [21, 22].

Exclusion Criteria:

1) Not an Alberta resident or not treated in an Alberta acute care facility;
2) Adjacent diagnosis related group (ADRG) defining hospitalization for a surgical procedure;
3) Any previous hospitalization within ten days of incident pneumonia case;
4) Atypical cases whose length of stay was greater than twice the third minus first quartile plus the third quartile (twenty-four days).

Home Care:

Identified pneumonia cases were merged with the home care databank using an anonymous personal identifier. Service hours, costs, and providers for home care during the two months prior to hospital admission and two months after hospital discharge were extracted. Atypical hospital discharges (6.4 percent of total) with long length of stays (more than twenty-four days) were excluded as outliers using Canadian Institute for Health Information criteria in order to merge all records prior to admission date. Atypically long

hospitalizations may be more related to comorbidity or complications rather than community-acquired pneumonia. Home care was either received at home or in a continuing care facility (long term care, seniors lodge, or other continuing care institution).

Severity of pneumonia was defined as any of:

- Transfer from another acute care facility as defined by re-admission to hospital for the diagnosis of pneumonia within forty-eight hours of previous discharge;
- Age (18 to 44, 45 to 64, 65 to 74, 75 to 84, or 85 or more years (age at the fiscal year end is used));
- Special/intensive care unit admission (defined by each hospital);
- Diagnosis code of respiratory failure or arrest (ICD-9-CM 518.81, 799.1);
- Diagnosis code of hypotension or shock (ICD-9-CM 458.xx, 785.5x);
- Procedure code for ventilation greater than ninety-six hours (ICD-9-CM 96.72);
- Procedure code for dialysis (ICD-9-CM 39.95, 54.98).

Comorbidity:

Charlson's comorbidities were calculated using established definitions [22, 23]. Length of stay was calculated as days between discharge and admission date. Alternate (not acute care as defined by the treating physician) level of care days were subtracted from the length of stay. Transfers were attributed to the index admission and cumulative hospital length of stay was calculated. All active hospital acute care beds in each year per resident region were surveyed and maintained in the provincial databases. Export was a primary admission to a hospital not within region of residence.

Defining Hospital Volume:

All hospitals in Alberta are administered by an autonomous regional board in each of seventeen health regions. All residents of Alberta enrolled in the public health care insurance plan reside in one of the seventeen health regions. Hospitals admitting patients with community-acquired pneumonia were categorized into five groups on the basis of the average number of hospital discharges per year between April 1, 1994 to March 31, 1999, geographic location, and medical school proximity:

Rural

- Less than fifty cases per year in seventy-seven hospitals;
- Fifty to one hundred and eight cases per year in twenty-seven hospitals;

The rural hospital cutoff values for pneumonia cases of fifty and one hundred and eight represented the 50th and 75th percentiles.

Regional

- Five hospitals located in one of the five non-metropolitan regional health care cities ranging from 67 to 251 cases per year and one high volume rural hospital accounting for 221 cases per year;

Metropolitan

- Seven hospitals located in the metropolitan health regions of Calgary and Capital hospitals ranging from 92 to 813 cases per year;
- Two hospitals located adjacent to medical schools with one hospital in each of two metropolitan centres ranging from 493 and 610 cases per year.

Hospital Costs:

Inpatient costing per resource group number (RGN) was calculated using the provincially approved methodology as set forth by the Provincial Costing Project and in accordance with the Provincial and National Management Information Systems guidelines [24, 25]. Total costs combine allocation and assignment of all direct and indirect costs associated with an inpatient encounter from the time a patient was admitted to the hospital to the time they were discharged. All costs were estimated in 1998/99 and assumed similar for all the study years. The quality of the data reporting of costs in Alberta has been highly ranked by the Canadian Institutes for Health Information [26]. As such, the methodological issues that arise around collection of cost data in the United States of America [27], in part due to the use of prices rather than costs, and for centres in Canada which cost admissions on the basis of "case-mix grouping", did not arise with the majority of the cost data considered in this analysis.

Home Care Costs:

Attributed costs to home care included patient service hours only and excluded travel times which were non attributable program costs. Home care service costs were not standardized between health regions. All amounts were expressed in 1998/99 dollars.

Calculating Distance to Nearest Hospital

Each hospital discharge was mapped to the centre of a postal code and distances as the "crow flies" between centroids calculated. Nearest local, regional referral and metropolitan referral hospital distance to resident postal code was obtained for all non-urban residents. Urban resident distances were zero. Rural resident travel distances greater than fifty kilometres were defined as remote.

Mortality:

Vital statistics declaration of death certificates were merged with the Alberta Health Care Premium Registry databank in order to determine de-registration from the plan. Reliability of linkage was high (99.5 percent) as verified by comparing in-hospital deaths recorded by hospital chart extraction to Alberta Health Care Premium Registry death derived from vital statistics.

Calculating age-specific hospitalization (death plus discharge) rates:

The three-year (April 1, 1996 to March 31, 1999) age-specific rate of pneumonia hospital discharges for seniors was calculated by five-year age increments. The population for home care was defined by all those that received any home care service within each of the three years that hospital discharges occurred. The long term care population was determined by census in August of each year. The remaining senior population was defined in each year by all those sixty-five years of age and older registered by Alberta Health Care and not in long term care or home care. To calculate standard error, patient's age at a fixed date was necessary, as a patient may have more than one hospital discharge in a year.

Calculating age-specific community-acquired pneumonia rates:

Three-year (April 1, 1996 to March 31, 1999) physician consultation claims (CPX 03.x, x20, x21) [29] for non-hospitalized community-acquired pneumonia (as defined above) were extracted from the Alberta Physician Claims Assessment System Database. All claims within ten days before or after hospitalization for community-acquired pneumonia were linked using the anonymous personal identifier and excluded. All subsequent claims within sixty days of first identified claim were excluded. Seniors were defined (mutually exclusive) as living at home with or without home care or in a long term care facility as defined above. Rates were calculated as described above.

Outcome Used in Regressions:

- hospital length of stay;
- designation alternate level of care while in an acute care hospital;
- in-hospital death per hospital discharge (pre-admission home care only);
- one-year mortality per hospital discharge (excluding in-hospital deaths);
- sixty-day all cause hospital re-admission (excluding in-hospital deaths and those who did receive home care prior to re-admission).

STATISTICS

Age-specific hospital discharge rates for patients receiving home care, long term care, or residence at home were compared using the ninety-nine percent confidence intervals.

A forward stepwise selection of factors was used to determine the order of importance of the factors influencing each outcome variable. The factor of interest was home care provided within two months before, after, or before and after hospitalization (home care at home or home care in continuing care institution). Covariates were year, age (18-44, 45-64, 65-74, 75-84, 85 or more), sex, residence in a continuing care institution, per capita number of acute care beds per resident region, hospital type as defined above, exported case (i.e. service region not equal to recipient region), transfer to another acute care hospital, urban or rural resident region, remote travel distance, special/intensive care unit admission, diagnosis code of respiratory failure/arrest, diagnosis code of hypotension/shock , procedure code for ventilation greater than ninety-six hours , procedure code for in-hospital dialysis, and number of comorbid diagnosis (0, 1, 2, > 2). The long term census did not include those residing in senior's lodges or other types of continuing care facilities which were included in the continuing care population defined by hospital abstract data. Substituting long term care residence for continuing care in the models did not appreciably alter the results based on home care, so they are not reported. The unit of analysis was hospital discharge with some patients being hospitalized on multiple occasions per year. We attempted to adjust for correlations in hospital discharges within the same subject, but it did not result in substantial difference from those under the assumption of zero correlation. Therefore, we opted to report results of a simpler approach based on multiple linear and logistic models [30, 31]. To control the large sample size effect on statistical significance, we used one-half random sample from the hospital discharges data for statistical modeling [32]. The results were validated with the entire data to test for bias in the sample. Data was analyzed using the program SAS 8 [SAS Institute Inc., Cary, NC, 2000] and significance was defined as $p < 0.05$.

RESULTS

Home care was extensively used by patients who required hospitalization for community-acquired pneumonia in Alberta both in the sixty days before and after hospitalization. The annual rate of hospitalization (Table 1) for community-acquired pneumonia was about 8,200 persons per annum at a cost of 35 million dollars per annum during the four study years (after excluding hospital discharges with an atypically long length of stay greater than twenty-four days). Home care was provided to twenty-two percent of patients who were at home (Figure 1) and thirty-two percent of patients who were receiving continuing care services in sixty days prior to their hospitalization for an annual cost of about 1 million dollars. After excluding hospital deaths, home care was provided to twenty-nine percent of patients who were at home and forty-one percent of patients who were receiving continuing care services in the sixty days after their hospitalization for an annual cost of about 1 million dollars. Total home care costs and hours delivered before and after hospitalization for community-acquired pneumonia increased forty-one percent and thirty-eight percent, respectively, between 1995/96 to 1998/99. In contrast, total hospital costs increased by eighteen percent in constant 1998/99 dollars comparing 1995/96 to 1998/99.

Figure 2a and 2b demonstrate the age-specific rates of hospital admission and incidence of non-hospitalized community-acquired pneumonia for seniors living at home without receiving home care, seniors living at home and receiving home care, and all seniors residing in a long term care facility recorded by yearly census (who do not receive any home care services). The admission rates for seniors residing in long term care were similar to seniors living at home and receiving home care for ages less than eighty years. As age increased, admission rates became similar to those living at home and not receiving home care. Non-hospitalized community-acquired pneumonia incidence rates for long term care residents were similar at all ages and significantly greater than seniors living at home.

Patient characteristics for those living at home and in a continuing care facility are given in Table 2. Those residing in continuing care were older and had higher mortality compared to those residing at home. For hospital discharges originating from home, those receiving home care were older, had higher rates of urban residence, comorbidity, alternate level of care designation, mortality, re-admissions, and a longer length of stay. For hospital discharges originating from continuing care, those receiving home care had a higher rate of rural residence, alternate level of care designation, and re-admissions but lower mortality rate.

Table 3 demonstrates the services that comprised home care. A home support aid accounted for fifty-seven percent of home care before hospital admission and fifty-four percent of home care after hospital discharge. Self care (financial support allowing the client to hire home care support privately) accounted for twenty-two percent of home care before hospital admission and nineteen percent of home care after hospital discharge. Professional care (nurse, LPN, respiratory therapy, occupational therapy) accounted for twenty-one percent of home care before hospital admission and twenty-six percent of home care after hospital discharge. Excluding self care, about sixty percent of all home care recipients had at least one contact with both a professional and non-professional provider, thirty-three percent with a professional provider only, and seven percent with a non-professional provider only.

Table 4 demonstrates the results of regression analysis. After adjustment for relevant factors as described in the statistical methods section, receiving home care (prior, post, both prior and post hospitalization) was associated with higher one-year mortality, longer length of hospital stay, and designation as alternate level of care. Receiving home care (prior to hospitalization) was associated with greater in-hospital mortality. Receiving home care (post hospitalization) was associated with more re-admissions to hospital.

DISCUSSION

Home care was provided to about a fifth of patients in the period before hospitalization and about a quarter of patients after hospitalization for community-acquired pneumonia. Patients who received home care services tended to be older, had more comorbidities, and had a higher mortality. Patients receiving home care had higher rates of hospitalization for community-acquired pneumonia, longer length of hospital stays, were more likely to remain in hospital after the acute care treatment period, and were more likely to be re-admitted to hospital after the initial discharge.

We noted significant differences in the process of care for community-acquired pneumonia for seniors residing at home compared to seniors residing in a continuing care facility. We restricted our contrasts to the ages of most long term care residents. The most striking difference was the non-increasing rate of hospitalization with age for community-acquired pneumonia for seniors residing in one type of continuing care facility (long term care) which was not the case for seniors living at home (with or without receiving home care). The different hospitalization rate for seniors living in a

long term care facility was not explained by the incidence of pneumonia which was higher in seniors living in a long term care facility at all ages. As well, home care, but not continuing care, was associated with a higher hospital re-admission rate. Home care was a stronger predictor for longer length of hospital stay compared to continuing care.

This study suggested that home care accentuated the use of acute care for community-acquired pneumonia by being utilized by a frail population of elderly persons and that home care supplemented by acute care appeared to be a substitute for continuing care services. Residence in a long term care facility was associated with a non-increasing rate of admission to hospital for community-acquired pneumonia because some of these patients are treated in the long term care facility. During acute care hospitalization, those receiving home care stayed in hospital longer and were designated alternate care to a greater extent than those who were transferred from a continuing care facility. Hospital re-admissions for those receiving home care (but not continuing care) added to the total duration of acute care hospitalization.

The impact of home care services upon the provincial health budget has increased as manifested by the increase in total home care hours provided by the program over the four study years. However, home care direct expenditure over the study period was only about 9 million dollars compared to the 140 million dollars expended upon hospitalization for community-acquired pneumonia. The average direct costs per home care patient of providing home care in the period surrounding an admission for community-acquired pneumonia was about a quarter of the average cost of the hospitalization itself. Health policy [14] emphasizing home care as a cost-efficient alternative to continuing care needs to consider the associated costs of potentially increased acute care services associated with those receiving home care. The approximate costs for long term care in Alberta ranged between $18,000 to $59,000 per annum dependant upon the required level of care [33].

There is some indication that in general [34] and specifically for community-acquired pneumonia [2, 35], hospital length of stays can be reduced without jeopardizing patient outcomes when medical services are provided at home. However, there is insufficient evidence to conclude that home care is a general substitute for acute care [36]. Considering community-acquired pneumonia, home intravenous antibiotic therapy may be an effective substitute for acute care [37-39]. However the short course of intravenous antibiotics required before substituting to an oral agent limits this specific indication in patients hospitalized with community-acquired pneumonia [40]. Given the high mortality rate for patients with community-acquired

pneumonia, home care may act as palliative care in the last months of life [41,42]. Eighteen percent of those receiving home care prior to hospitalization died during their hospitalization. However we found the opposite for continuing care patients who were more likely to die if they did not receive home care. Home care may also increase preventative care services such as influenza vaccination although this type of care did not alter overall hospitalization rates in one study [8]. Home care provided in Alberta for those admitted with community-acquired pneumonia is predominantly home support. Thus, the nature of home care provided is more in keeping with a substitution for continuing care rather than acute care services. Trials that test the efficacy of medical or nursing services delivered in the home are not applicable to the predominant type of service (eighty percent home support) delivered to patients with community-acquired pneumonia.

Population-based administrative database research is highly generalizable although limited in clinical details. We attempted to adjust for case severity (hypotension/shock, respiratory arrest/failure, ventilation, special care unit admission, export to another region, transfer to another hospital) and case mix (comorbidity, transfer from continuing care, age, sex) but may not have captured all variation [43]. These variables are likely less reliable than a clinically derived pneumonia index [1]. The increased risk of mortality for residents of continuing care and those receiving home care noted in this study and others [43] is likely due to increased comorbidity. Studies such as ours do not account for patient preferences, health related quality of life benefits, and societal costs including informal uncompensated care by family members. More rigourous accounting for total costs and benefits of home care are warranted. Future studies that test the usefulness of home support should consider the hand-offs between acute care and home care. Home care is provided to the old and frail and in the old and frail, community-acquired pneumonia is often a harbinger of death. Although home care may eventually prove to be an efficacious and/or cost-efficient method of delivering health care, the strong statements of benefit by health policy analysts seem to be premature at this time.

In conclusion, home care before hospitalization for community-acquired pneumonia was delivered to elderly patients with more comorbidity and higher mortality (in-hospital death odds ratio 1.85 (95% CI 1.64-2.08), one year death odds ratio = 2.00 (95% CI 1.57-2.54). Patients who received home care after hospitalization had longer length of hospital stays odds ratio = 1.38 (95% CI 1.33-1.43), were more likely to remain in hospital after the acute care treatment period odds ratio = 4.11 (95% CI 2.26-7.46), and were more likely to be re-admitted to hospital after the initial discharge odds ratio = 1.16 (95% CI 1.06-1.27). Eighty-four percent of patients who

received home care prior to admission also received these services after hospital discharge.

FIGURE LEGEND

Figure 1 is a flow diagram illustrating the population of patients with pneumonia who received home care both before and after hospitalization. Ninety-one percent of patients who were discharged to continuing care also received continuing care prior to admission. Seven percent of those receiving home care prior to hospitalization were discharged to continuing care. Eighty-four percent of patients who received home care prior to hospitalization (excluding those in continuing care) also received home care post hospitalization. Eighty-three percent of persons who received no home care prior to hospitalization (excluding those in continuing care) also received no home care post hospitalization. Home care hospital discharges receiving continuing care accounted for about thirteen percent of all home care services prior and post hospitalization. Home care delivered to continuing care recipients was predominately for those located in senior citizen's lodges or auxiliary care residences (about seventy-five percent).

Figure 2a shows the age-specific hospital admission rate for seniors at home receiving no home care, seniors at home receiving home care, and seniors residing in long term facilities (who did not receive home care). We restricted our contrasts to the ages of most long term care residents. The age-specific rate of hospitalization for community-acquired pneumonia in seniors living at home significantly increased from seven per one thousand in seniors sixty-five to seventy years to forty-three per one thousand in seniors ninety or more years. The age-specific rate of hospitalization for community-acquired pneumonia in seniors living at home and receiving home care significantly increased from forty-two per one thousand in seniors sixty-five to seventy years to eighty per one thousand in seniors ninety or more years. The age-specific rate of hospitalization for community-acquired pneumonia in seniors residing in long term care remained near constant at thirty-three per one thousand in seniors sixty-five to seventy years to thirty-two per one thousand in seniors ninety or more years.

Figure 2b shows the incidence for age-specific diagnosis of pneumonia in the community for seniors at home receiving no home care, seniors at home receiving home care, and seniors residing in long term facilities (who did not receive home care). We restricted our contrasts to the ages of most long term care residents. The age-specific rate of non-hospitalized community-acquired pneumonia in seniors living at home significantly increased from forty-four per one thousand in seniors sixty-five to seventy

years to seventy-seven per one thousand in seniors ninety or more years. The age-specific rate of hospitalization for community-acquired pneumonia in seniors living at home and receiving home care significantly increased from ninety-two per one thousand in seniors sixty-five to seventy years to one hundred and nineteen per one thousand in seniors ninety or more years. The age-specific rate of hospitalization for community-acquired pneumonia in seniors residing in long term care remained near constant at one hundred and eleven per one thousand in seniors sixty-five to seventy years to one hundred and thirty-seven per one thousand in seniors ninety or more years.

REFERENCES

1. Marrie, T.J., Lau, C.Y., Wheeler, S.L., Wong, C.J., Vandervoort, M.K., and Feagan, B.G., A Controlled Trial of a Critical Pathway for Treatment of Community-Acquired Pneumonia, *JAMA*, 2000; 283: 749-755

2. Marrie, T.J., Results of the First Six Months of a Critical Pathway in Edmonton, Unpublished data

3. Fine, M.J., Auble, T.E., Yealy, D.M., Hanusa, B.H., Weissfeld, L.A., Singer, D.E., Coley, C.M., Marrie, T.J., and Kapoor, W.N., A Prediction Rule to Identify Low-Risk Patients with Community-Acquired Pneumonia, *N Engl J Med*, 1997; 336: 243-250

4. Roson, B., Carratala, J., Dorca, J., Casanova, A., Manresa, F., and Gudiol, F., Etiology; Reasons for Hospitalization, Risk Classes, and Outcomes of Community-Acquired Pneumonia in Patients Hospitalized on the Basis of Conventional Admission Criteria, *Clin Infect Dis*, 2001; 33: 158-165

5. Porath, A., Schalaeffer, F., and Lieberman, D., Appropriateness of Hospitalization of Patients with Community-Acquired Pneumonia, *Ann Emerg Med*, 1966; 27: 176-183

6. Gertman, P. and Restucia, J., The Appropriateness Evaluation Protocol; A Technique for Assessing Unnecessary Days of Hospital Care, *Med Care*, 1981; 19: 855-871

7. Marras, T.K., Gutierrez, C., and Chan, C.K., Applying a Prediction Rule to Identify Low-Risk Patients With Community-Acquired Pneumonia, *Chest*, 2000; 118: 1,339-43

8. Dalby, D.M., Sellors, J.W., Fraser, F.D., Fraser, C., van Ineveld, C., and Howard, M., Effect of Preventative Home Visits by a Nurse on the Outcomes of Frail Elderly People in the Community; A Randomized Controlled Trial, *CMAJ*, 2000; 162: 497-500

9. Fried, T.R., van Doorn, C., O'Leary, J.R., Tinetti, M.E., and Drickamer, M.A., Older Persons' Perceptions of Home and Hospital as Sites of Treatment for Acute Illness, *American Journal of Medicine*, 1999; 107: 317-23

10. Fried, T.R., van Doorn, C., Tinetti, M.E., and Drickamer, M.A., Older Persons' Preferences for Site of Treatment in Acute Illness, *Journal of General Internal Medicine*, 1998; 13: 522-7

11. Maxwell, C.J., Quan, H., Hogan, B., and Zhang, J.X., Trends in Hip Fracture Hospitalizations and Associated Health Outcomes in Alberta (1994-97), Alberta Centre for Health Services Utilization Research, 2001

12. Kane, R.L., Chen, Q., Finch, M., Blewett, I., Burns, R., and Moskowitz, M., Functional Outcomes of Posthospital Care for Stroke and Hip Fracture Patients Under Medicare, *J Am Geriatr Soc*, 1998; 46:1,525-33

13. Stewart, S., Vandenbroek, A.J., Pearson, S., and Horowitz, J.D., Prolonged Beneficial Effects of a Home-Based Intervention on Unplanned Re-admissions and Mortality Among Patients with Congestive Heart Failure, *Arch Intern Med*, 1999; 159: 257-61

14. National Forum on Health Final Report - Volume I, Canada Health Action: Building on the Legacy, Health Canada Communications, Ottawa, Ontario, http://wwwnfh.hc-sc.gc.ca/

15. Report on the National Roundtable on Home and Community Care, Minister of Public Works and Government Services Canada Ottawa, Ontario, 1999, http://www.hc-sc.gc.ca/english/care/home_care.html

16. The National Advisory Council on Aging Position on Home Care, Minister of Public Works and Government Services Canada. Ottawa, Ontario, 1999, http://www.hc-sc.gc.ca/english/care/home_care.html

17. Provincial and Territorial Home Care Programs; A Synthesis for Canada, Health Canada, http://wwwnfh.hc-sc.gc.ca/publicat/finvol1/5integ.htm

18. Anderson, M.A., Pena, R.A., and Helms, L.B., Home Care Utilization by Congestive Heart Failure Patients; A Pilot Study, Public Health Nursing, 1998; 15: 146-62

19. Long, C.O., Ismeurt, R., and Wilson, L.W., The Elderly and Pneumonia, Prevention and Management, Home Healthcare Nurse, 1995; 13: 43-7

20. Marrie, T.J., Durant, H., and Sealy, E., Pneumonia – The Quality of Medical Records, *Medical Care*, 1987; 25: 20-24

21. Draper, D., Kahn, K.L., Reinisch, E.J., Sherwood, M.J., Carney, M.F., Kosecoff, J., Keeler, E.B., Rogers, W.H., Savitt, H., Allen, H., Wells, K.B., Reboussin, D., and Brook, R.H., Studying the Effects of the DRG Based Prospective Payment System on Quality of Care, *JAMA*, 1990; 264: 1,956-1,961

22. Deyo, R.A., Cherkin, D.C., and Ciol, M.A., Adapting a Clinical Comorbidity Index for use With ICD-9-CM Administrative Databases, *Journal of Clinical Epidemiology*, 1992; 45: 613-9

23. Romano, P.S., Roos, L.L., and Jollis, J.G., Adapting a Clinical Comorbidity Index for use with ICD-9-CM Administrative Data; Differing Perspectives, *Journal of Clinical Epidemiology*, 1993; 46: 1,075-9

24. Regional Health Authority Global Funding Manual, 2000-01, in Funding Health Resourcing Branch, Alberta Health and Wellness, March, 2000, Edmonton, Alberta

25. Guidelines for Management Information Systems in Canadian Health Service Organizations, Canadian Institute for Health Information, 1999, Ottawa, Ontario

26. McKillop, I., Pink, G.H., and Johnson, L.M., The Financial Management of Acute Care in Canada; A Review of Funding, Performance Monitoring and Reporting Practices, Canadian Institute for Health Information, 2001, Ottawa, Ontario p 83

27. Magnus, S.A. and Smith, D.G., Better Medicare Cost Report Data are Needed to Help Hospitals Benchmark Costs and Performance, *Health Care Manage Rev*, 2000; 25: 65-76

28. Carrière, K.C. and Roos, L.L., Comparing Standardized Rates of Events, *Am J Epidemiol*, 1994; 140: 472-82

29. Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedures, Second Printing, Statistics Canada, Health Division Nosology Reference Centre Minister of Supply and Services, 1986, Ottawa, Canada

30. Seber, (1977), Linear Regression Analysis, Wiley, New York

31. Hosmer, D.W. and Lemeshow, S., (1989), Applied Logistic Regression, John Wiley and Sons, New York

32. Cree, M., Roos, N., Yang, Q., and Carrière, K.C., Hypertensive Patients and their General Practitioners, Healthcare Management Forum, 2001; 14: 33-40

33. Regional Health Authority Global Funding Manual, Health Resourcing Branch, Alberta Health and Wellness, 2000, Edmonton, Alberta

34. Jacobs, P., Henderson, I., and Nicholas, D., Episodic Acute Care Costs; Linking Inpatient and Home Care, Queen's-University of Ottawa Economic Projects, 1994; 394-07

35. The Cost-Effectiveness of Home Care; A Rigourous Review of the Literature, Health Services Utilization and Research Commission, September, 1996

36. Hughes, S.L., Weaver, F.M., Giobbie-Hurder, A., Manheim, L., Henderson, W., Kubal, J.D., Ulasevich, A., and Cummings, J., Effectiveness of Team-Managed Home-Based Primary Care; A Randomized Multicenter Trial, *JAMA*, 2000; 284: 2877-85

37. Balinsky, W. and Nesbitt, S., Cost-Effectiveness of Outpatient Parental Antibiotics; A Review of the Literature, *The American Journal of Medicine*, 1989; 87: 301-5

38. Williams, D.N., Reducing Costs and Hospital Stay for Pneumonia With Home Intravenous Cefotaxime Treatment; Results With a Computerized Ambulatory Drug Delivery System, *American Journal of Medicine*, 1994; 97: 50-5

39. Morales, J.O. and Snead, H., Efficacy and safety of intravenous cefotaxime for treating pneumonia in outpatients, *American Journal of Medicine*, 1994; 97: 28-33

40. Brown, R.B., Outpatient parenteral antibiotic therapy in the management of community-acquired lower respiratory infections, Infectious Disease Clinics of North America, 1998: 12; 921-33

41. Brooks, C.H., A comparative analysis of medicare home care cost savings for the terminally ill, Home care Services Quartely, 1989; 10: 79-96

42. Mor, V. and Kidder, D., Cost savings in hospice: final results of the National Hospice Study Health Services Research, 1985; 20: 407-22

43. Ewig, S., Ruiz, M., Mensa, J., Marcos, M.A., Martinez, J.A., Arancibia, F., Niederman, M.S., and Torres, A., Severe community-acquired pneumonia, Assessment of severity criteria, *American Journal of Respiratory and Critical Care Medicine*, 1998; 158: 1,102-8.

Table 1 – Utilization of home care (number and percent) by adults hospitalized with community-acquired pneumonia (CAP) in Alberta during 1995/96 to 1998/99

	Year 95/96	Year 96/97	Year 97/98	Year 98/99	Average during four-year period
Four year total of hospital discharges for CAP after excluding atypical length of stay	7,268 (23%)	7,736 (24%)	8,583 (27%)	8,716 (27%)	32,303
Hospital discharges for CAP receiving home care prior to admission	1,307 (18%)	1,525 (20%)	1,694 (20%)	1,798 (21%)	6,324 (20%)
Hospital discharges for CAP receiving continuing care and home care prior to admission	228 (3.1%)	223 (2.9%)	288 (3.4%)	294 (3.4%)	1,033 (3.2%)
Time (in hours) and costs (dollars) of receiving home care prior to admission	53,735 hours $921,825	61,504 hours $1,055,471	67,352 hours $1,177,328	71,842 hours $1,266,024	254,400 hours $4,419,800
Hospital discharges for CAP receiving home care after discharge	1,670 (26%)	1,863 (27%)	2,041 (27%)	2,234 (28%)	7,808 (27%)
Hospital discharges for CAP receiving continuing care and home care after discharge	201 (3.1%)	261 (3.7%)	261 (3.4%)	297 (3.8%)	1,020 (3.5%)
Time (in hours) and costs (dollars) of receiving home care after discharge	52,346 hours $958,858	57,871 hours $1,059,197	65,597 hours $1,220,047	74,443 hours $1,391,077	250,189 hours $4,627,203
Total hospital costs (dollars)	$31,801,000	$33,995,000	$37,144,000	$37,669,000	$140,609,000
Average hospital costs per patient (dollars)	$4,375	$4,394	$4,328	$4,322	$4,353
Average home care cost before and after hospital discharge for those receiving home care (dollars)	$1,226	$1,208	$1,208	$1,271	$1,229

Table 2 – Demographics, length of stay and outcomes for patients hospitalized for treatment of community-acquired pneumonia (number and percent) in Alberta during 1995/96 to 1998/99 according to home care or continuing care status

	Hospital discharges receiving home care prior to admission and living at home n = 6,324	Hospital discharges receiving no home care prior to admission and living at home n = 22,696	Hospital discharges receiving home care and living in continuing care prior to admission (excluding those living at home) n = 1,033	Hospital discharges receiving no home care and living in continuing care to admission (excluding those living at home) n = 2,250
Female	3,248 (51.4%)	10,654 (46.9%)	568 (55.0%)	1,128 (50.1%)
Age (mean, sd)	75.6 (14.3)	61.1 (19.5)	83.8 (8.7)	81.1 (11.9)
Urban region of residence	3,012 (47.6%)	9,034 (39.8%)	401 (38.8%)	1,285 (57.1%)
Comorbidity (mean, sd)	1.44 (1.14)	0.87 (0.99)	1.48 (1.14)	1.51 (1.27)
Alternate level of care designation	194 (3.1%)	96 (0.4%)	57 (5.5%)	7 (0.3%)
Mean (median) length of stay in days	8.45 (7)	6.33 (5)	8.25 (7)	7.54 (6)
All cause sixty day re-admissions (excluding hospital deaths)	1,854 (36.0%)	4,360 (20.4%)	250 (31.0%)	340 (20.0%)
In-hospital mortality	1,175 (18.6%)	1,339 (5.9%)	226 (21.9%)	550 (24.4%)
One-year deaths per 100 hospital discharges	2,792 (44.2%)	3,668 (16.4%)	502 (48.6%)	1,283 (58.0%)

Table 3 – Providers of home care for hospitalized community-acquired pneumonia in Alberta during 1995/96 to 1998/99

Provider type	Pre-admission home care hours (including receiving both home care and continuing care)	Pre-admission home care costs (including receiving both home care and continuing care)	Post-discharge home care hours (including receiving both home care and continuing care and excluding hospital deaths)	Post-discharge home care dollars (including receiving both home care and continuing care and excluding hospital deaths)
Self-managed care project	56,276	$733,481	47,944	$624,879
Home support aide	144,856	$2,046,777	135,616	$1,916,213
Nurse	37,721	$1,209,067	49,086	$1,573,329
Licensed practical nurse	4,944	$95,816	4,047	$78,418
Respiratory therapist	1,431	$48,089	1,948	$65,474
Occupational therapist	3,221	$108,051	3,729	$125,092
Physiotherapist	2,481	$82,224	4,089	$135,529
Other health care professional	674	$17,626	720	$18,843
Social worker	1,627	$54,763	1,856	$62,473
Clerical worker	7	$90	5	$67
Supervisor	733	$21,025	874	$25,093
Volunteer	431	$2,791	277	$1,792

Table 4a – Logistic regression analyses of factors predictive of in-hospital and one-year mortality for patients hospitalized community-acquired pneumonia in Alberta during 1995/96 to 1998/99

Outcome: in-hospital mortality	Odds ratio and 95% confidence interval	Outcome: one-year mortality rate	Odds ratio and 95% confidence interval
Respiratory failure/arrest	5.5 (4.6- 6.7)	Continuing care	2.9 (2.5-3.3)
Continuing care prior to hospitalization	2.2 (1.9-2.5)	Comorbidity	
		(1)	1.8 (1.6-2.1)
		(2)	3.0 (2.6-3.4)
		(> 2)	4.3 (3.7-5.1)
Comorbidity		Home care prior to hospitalization	2.0 (1.6-2.5)
(1)	2.0 (1.7-2.4)		
(2)	3.4 (2.8-4.1)		
(> 2)	4.7 (3.9-5.8)		
Home care prior to hospitalization	1.9 (1.6-2.1)	Home care post hospitalization	1.7 (1.5-2.0)
Hypotension/shock	4.3 (3.3-5.7)	Home care prior/post hospitalization	2.1 (1.9-2.4)
Age		Female	0.62 (0.57-0.69)
45 to 64 years	1.8 (1.3-2.5)		
65 to 74 years	2.3 (1.7-3.2)		
75 to 84	2.9 (2.2-4.0)		
85 or more	5.1 (3.8-7.0)		
Special/intensive care admission	2.1 (1.7 -2.5)	Transfer to acute hospital	2.6 (1.9-3.5)
		Age	
		45 to 64 years	2.0 (1.6-2.5)
		65 to 74 years	2.5 (2.0-3.1)
		75 to 84	2.7 (2.2-3.4)
		85 or more	3.4 (2.7-4.3)
		Export	1.5 (1.3-1.7)
		Respiratory failure/arrest	1.5 (1.2- 1.9)

Note: based on 1/2 of the hospital discharge data who had live hospital discharge. The order of variables indicate the order of significance.

Table 4b – Logistic regression analyses for predicting sixty-day re-admission and alternate level of care and multiple linear regression analysis for log-length of stay for patients hospitalized with community-acquired pneumonia in Alberta during 1995/96 to 1998/99

Outcome: sixty-day re-admission	Odds ratio and 95% confidence interval	Outcome: alternate level of care	Odds ratio and 95% confidence interval	Outcome: log of average length of hospital stay	Relative risk and 95% confidence interval
Comorbidity		Continuing care	14 (9.3-21)	Age	
(1)	1.6 (1.4-1.7)			45 to 64 years	1.2 (1.2-1.3)
(2)	2.0 (1.8–2.3)			65 to 74 years	1.4 (1.3-1.4)
(> 2)	2.4 (2.1-2.8)			75 to 84	1.4 (1.4-1.5)
				85 or more	1.5 (1.4-1.6)
Remote distance to regional hospital	1.2 (1.1-1.4)	Home care prior to hospitalization	16 (9.6-28)	Comorbidity	
				(1)	1.1 (1.1-1.2)
				(2)	1.3 (1.2-1.3)
				(> 2)	1.3 (1.3-1.4)
Special/intensive care admission	1.4 (1.2-1.6)	Home care post hospitalization	4.1 (2.3-7.5)	Home care prior to hospitalization	1.1 (1.05-1.2)
Exported	1.4 (1.3 -1.6)	Home care prior/post hospitalization	5.9 (3.7-9.4)	Home care post hospitalization	1.4 (1.3-1.4)
Hospital		Hospital beds per capita	0.43 (0.30-0.60)	Home care prior/post hospitalization	1.3 (1.2-1.3)
Rural (50 to 108 cases per year)	1.1 (0.95-1.2)				
Regional	1.1 (0.87-1.2)				
Urban (metropolitan)	0.83 (0.72-0.96)				
Urban (hospitals in proximity to a medical school metropolitan)	1.0 (0.87-1.2)				
Home care post hospitalization	1.2 (1.06-1.3)	Age		Hospital	
		65 to 74 years	1.8 (0.62-5.3)	Rural (50 to 108 cases per year)	1.04 (1.01-1.07)
		75 to 84	4.0 (1.5-10)	Regional	1.1 (1.08-1.2)
		85 or more	5.2 (2.0-14)	Urban (metropolitan)	1.3 (1.2-1.3)
				Urban (hospitals in proximity to a medical school metropolitan)	1.3 (1.2-1.3)
Female	0.85 (0.79-0.92)	Comorbidity		Transfer to acute hospital	1.9 (1.8-2.05)
		(1)	1.1 (0.69-1.8)		
		(2)	1.8 (1.1-2.9)		
		(> 2)	1.2 (0.68-2.1)		
Respiratory failure/arrest	1.5 (1.2-1.9)	Transfer to acute hospital	3.2 (1.2-8.8)	Ventilation	1.8 (1.5-2.1)
In-hospital dialysis	2.1 (1.2-3.4)			Respiratory failure/arrest	1.3 (1.2-1.4)
Hypotension/shock	1.4 (1.0-1.9)			Continuing Care	1.2 (1.1-1.2)
Age				Special/intensive care admission	1.1 (1.09-1.2)
45 to 64 years	1.2 (1.0-1.3)				
65 to 74 years	1.2 (1.07-1.4)				
75 to 84	1.3 (1.1-1.5)				
85 or more	1.3 (1.1-1.5)				
				Hypotension/shock	1.1 (1.03-1.3)
				Export	0.97 (0.93-0.99)
				In-hospital dialysis	1.2 (1.02-1.4)
				Remote distance to metropolitan hospital	1.1 (1.1-1.2)
				Remote distance to regional hospital	0.91 (0.87-0.95)

Note: based on 1/2 of the hospital discharge data who had live hospital discharges. The order of variables indicate the order of significance.

Figure 1 – Flow diagram of patient location prior to admission and post discharge

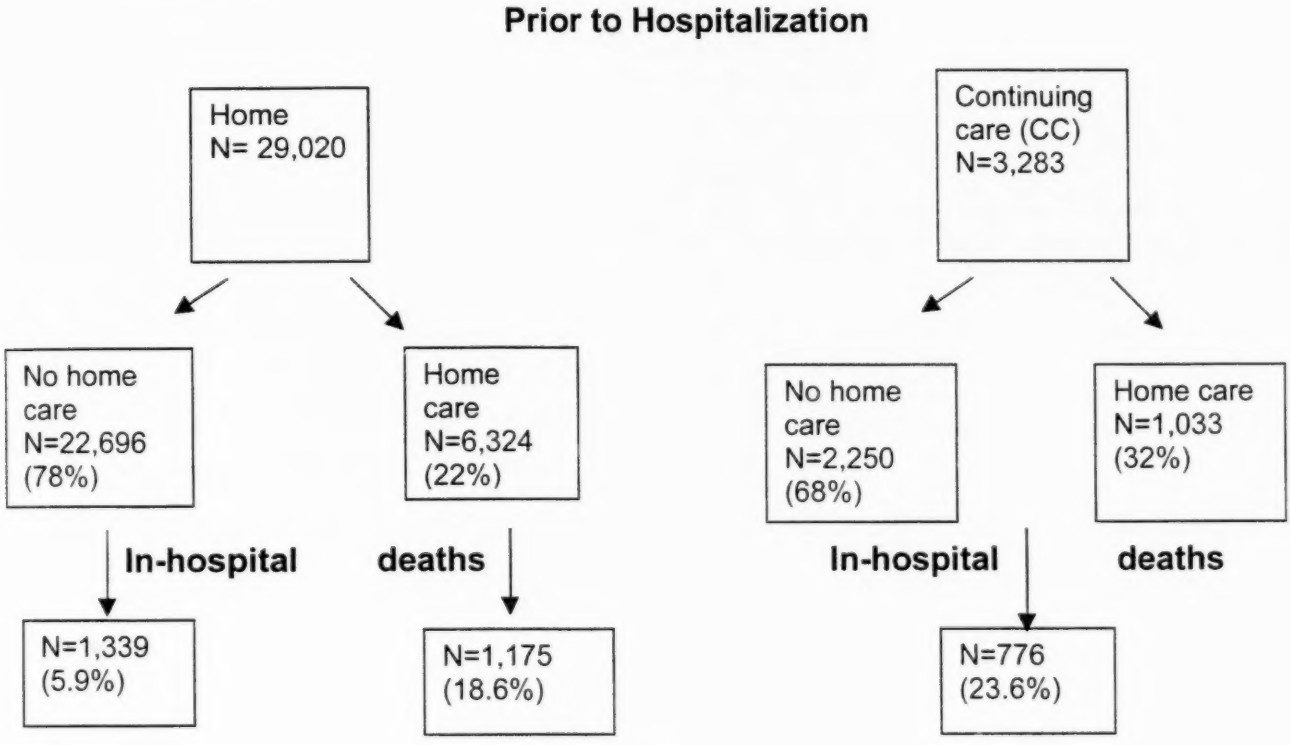


Figure 1 – Flow diagram of patient location prior to admission and post discharge – continued

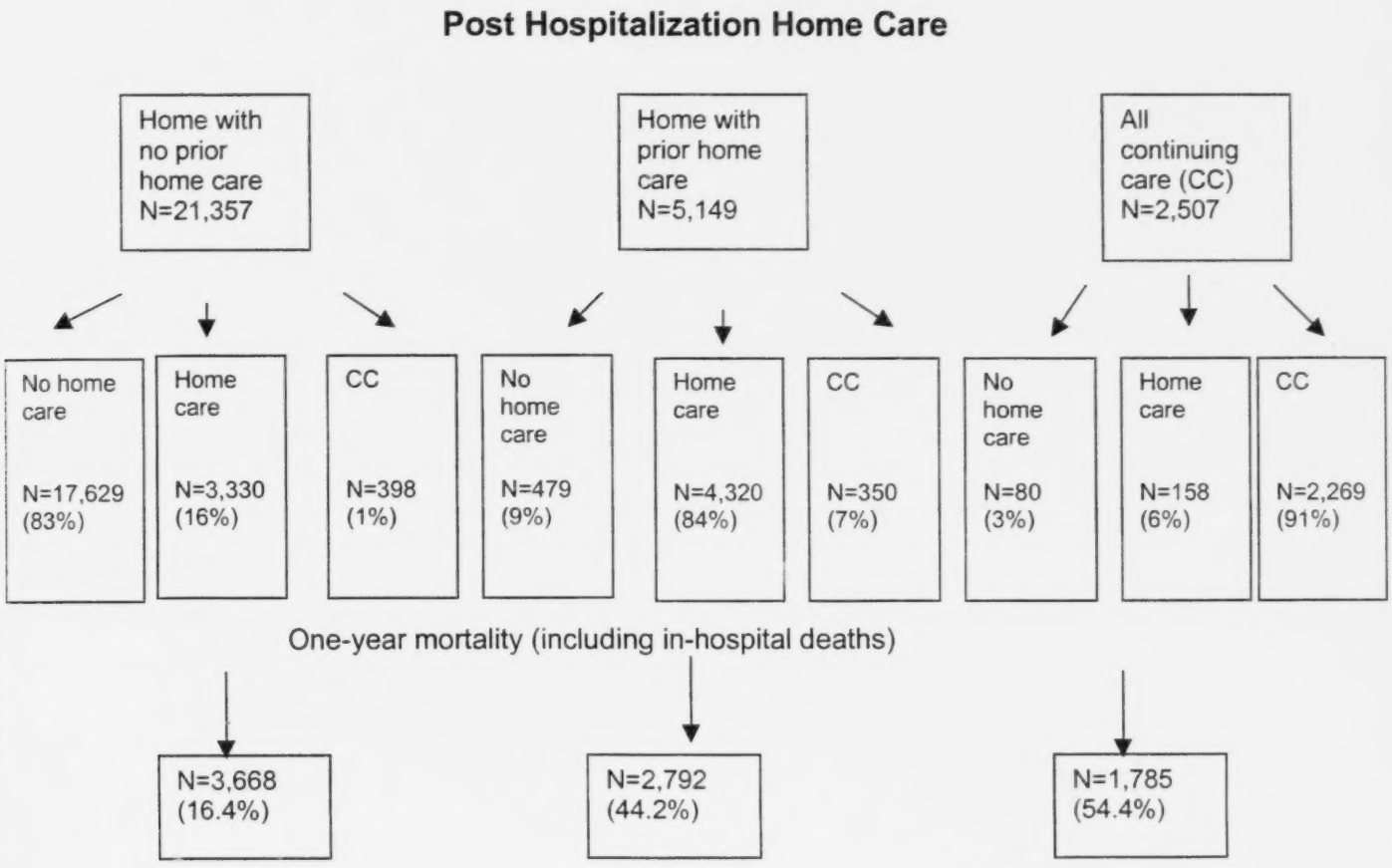

Post Hospitalization Home Care
Home with no prior home care N=21,357
Home with prior home care N=5,149
All continuing care (CC) N=2,507
No home care N=17,629 (83%)
Home care N=3,330 (16%)
CC N=398 (1%)
No home care N=479 (9%)
Home care N=4,320 (84%)
CC N=350 (7%)
No home care N=80 (3%)
Home care N=158 (6%)
CC N=2,269 (91%)
One-year mortality (including in-hospital deaths)
N=3,668 (16.4%)
N=2,792 (44.2%)
N=1,785 (54.4%)

Figure 2a – Three-year average age-specific hospital admission rates (99% confidence interval) for seniors: 1996/97 - 1998/99

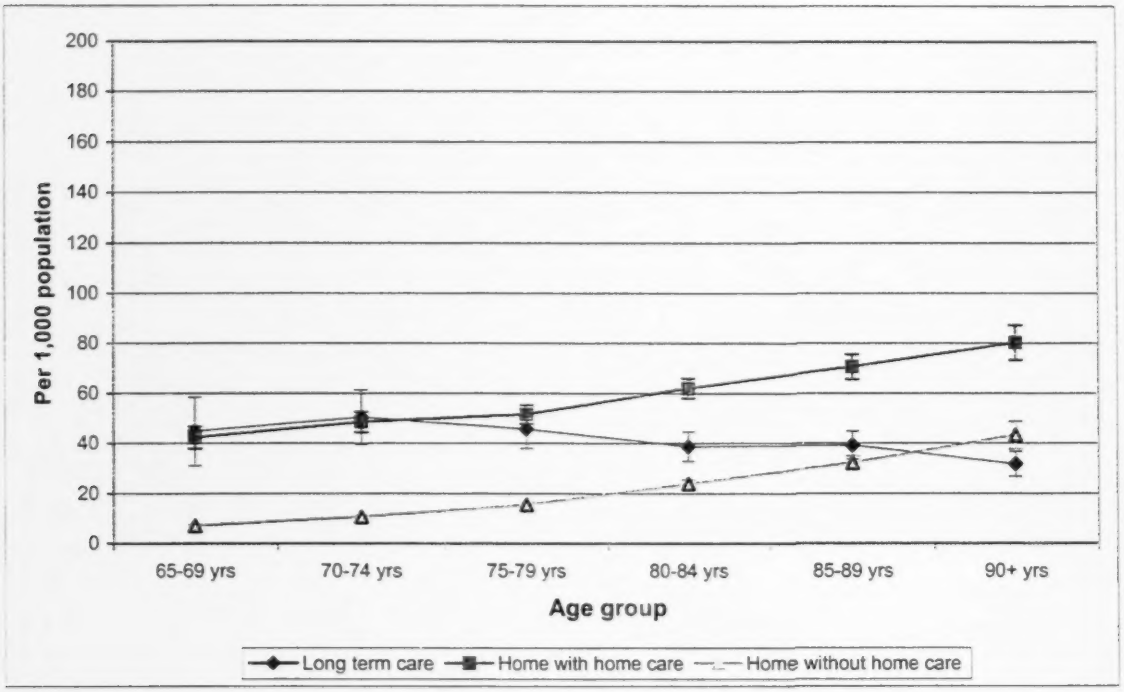
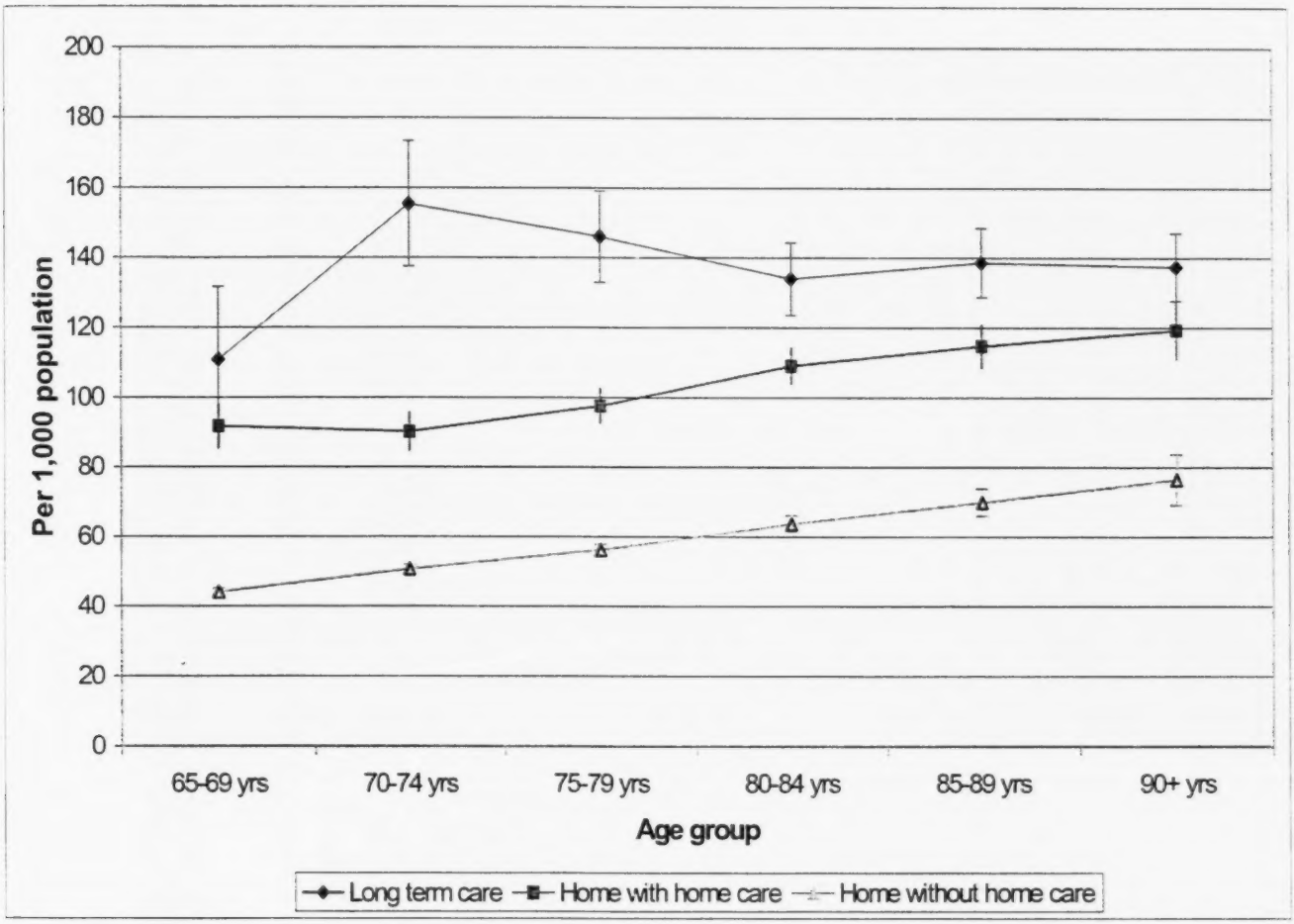


Figure 2b –Three-year average age-specific non-hospitalized pneumonia rates (99% confidence interval) for seniors: 1996/97 - 1998/99



APPENDIX

Appendix A - Residence region demographics for hospitalized community-acquired pneumonia in Alberta during 1994/95 to 1998/99

Residence Region	Hospital discharges receiving home care prior to admission n=7,357	Hospital discharges receiving no home care prior to admission n=24,946	Percent receiving home care before admission	Hospital discharges receiving home care after discharge (excluding and hospital deaths) n=8,828	Hospital discharges receiving no home care after discharge (excluding and hospital deaths) n=20,185	Percent receiving home care after discharge
1	452	1,709	20.9%	553	1,412	28.1%
2	234	1,143	17.0%	248	998	19.9%
3	272	715	27.6%	322	580	35.7%
4	1,521	4,875	23.8%	2,016	3,593	35.9%
5	158	762	17.2%	215	646	25.0%
6	557	2,314	19.4%	653	1,960	25.0%
7	485	1,526	24.1%	559	1,304	30.0%
8	227	692	24.7%	245	603	28.9%
9	205	834	19.7%	259	707	26.8%
10	1,892	5,444	25.8%	2,231	3,996	35.8%
11	366	1,056	25.7%	416	910	31.4%
12	402	1,623	19.9%	470	1,425	24.8%
13	305	885	25.6%	336	772	30.3%
14	93	385	19.5%	119	341	25.9%
15	96	534	15.2%	91	516	15.0%
16	51	206	19.8%	56	186	23.1%
17	41	243	14.4%	39	236	14.2%

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Summary of "Home Care Predicts an Increase in Admission Rate and Adverse Outcomes From Community-Acquired Pneumonia"

By D. Johnson, Y. Jin, K.C. Carrière, G. Predy, and T.J. Marrie

Purpose

The decision to admit a patient to hospital rather than providing care in the home is multifaceted and may be influenced by inadequate home support. This study describes the use of home care both before and after hospitalization for community acquired pneumonia. The association of home care with the hospitalization rate and duration, re-admission rate, and mortality was assessed.

Approach

Hospital admissions for community acquired pneumonia from April 1, 1996 to March 31, 1999 were analyzed using hospital abstracts.

Key findings

The following are the key findings of this study:

- The study consisted of 32,303 patients hospitalized for community-acquired pneumonia. Of these, 22,696 were living at home; 6,324 were living at home with home care; and 3,283 were residents of a continuing care facility.
- Patients who receive home care services are appropriately selected as they are older, have more "other illness", and have higher mortality.
- Over eighty percent of patients that receive home care prior to hospital admission also received these services after hospital discharge.
- Patients receiving home care have higher rates of hospitalization for community acquired pneumonia, longer lengths of hospital stay, are more likely to remain in hospital after the acute care treatment period, and are more likely to be re-admitted to hospital after the initial discharge.
- Some significant differences were noted in the process of care for community acquired pneumonia when comparing those residing at home to those residing in a continuing care facility. For those residing in long term care facilities, the hospitalization rate did not increase with age. However, for those residing at home (with or without receiving home care), the hospitalization rate did increase. The different hospitalization rate for those living in a long term care facility was not explained by incidence of pneumonia which was higher in those living in a long term care facility at all ages.

Summary of "Home Care Predicts an Increase in Admission Rate and Adverse Outcomes From Community-Acquired Pneumonia"

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Conclusions

The results suggest that home care supplemented by acute care is a substitute for continuing care services. When faced with the possibility of hospital admission for community acquired pneumonia, residing in a long term care facility (especially for the very old) limits hospital admissions. During acute care hospitalization, survivors are evaluated - some discharged home, some discharged to continuing care, and many resume the home care that had been provided prior to admission. The in-hospital evaluation for those not residing in a continuing care facility may in part explain the increased length of hospitalization and designation of alternate level of care. More frequent hospital re-admissions for those receiving home care (but not continuing care) adds further hospital days.

For more information

Copies of the report are available from the
Alberta Centre for Health Services Utilization Research

- by contacting David Johnson by e-mail at cujecjohnson@shaw.ca
- at http://www.health.gov.ab.ca/system/key/Research/achsur_reports.html

Alberta Centre for Health Services Utilization Research

The Alberta Centre for Health Services Utilization Research is a joint initiative between the University of Alberta and the University of Calgary, funded by Alberta Health and Wellness. The Centre conducts studies of how health services are used and delivered to inform health policy development and management of health services delivery.

Release date

December, 2002